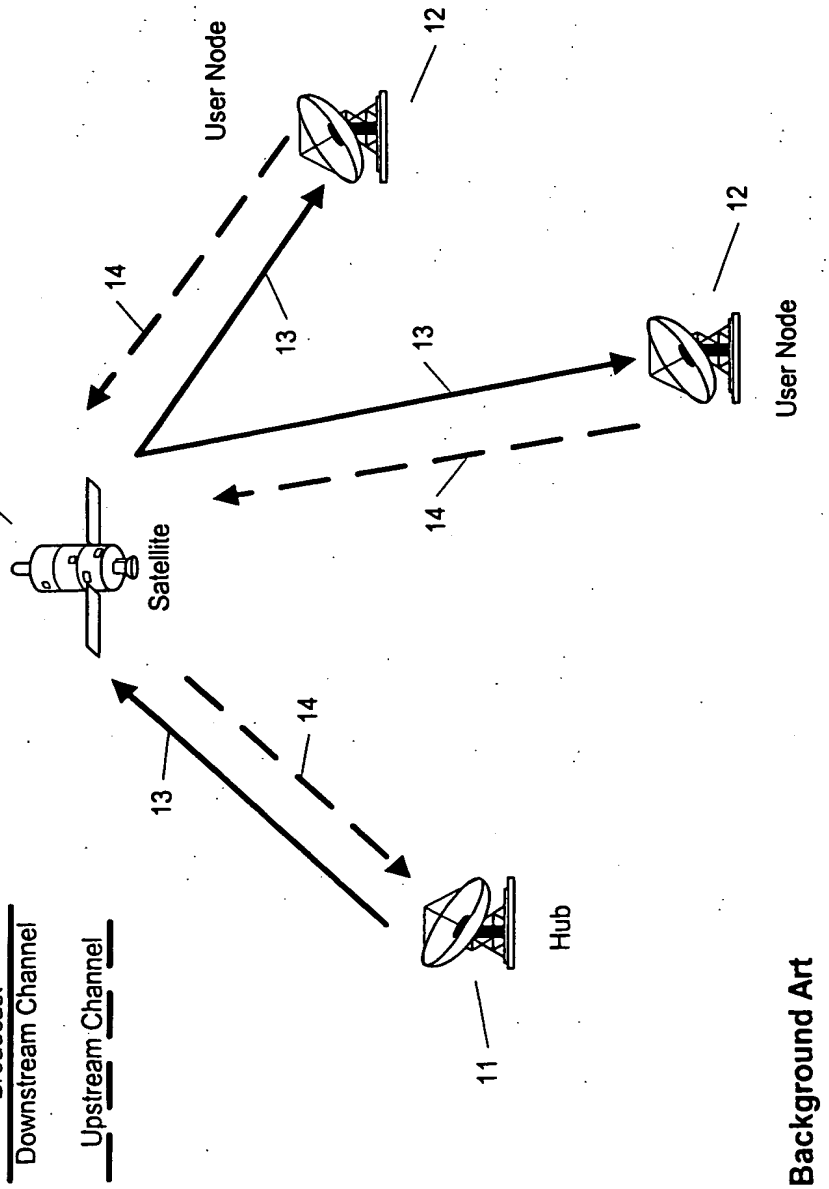


FIG. 1

Background Art

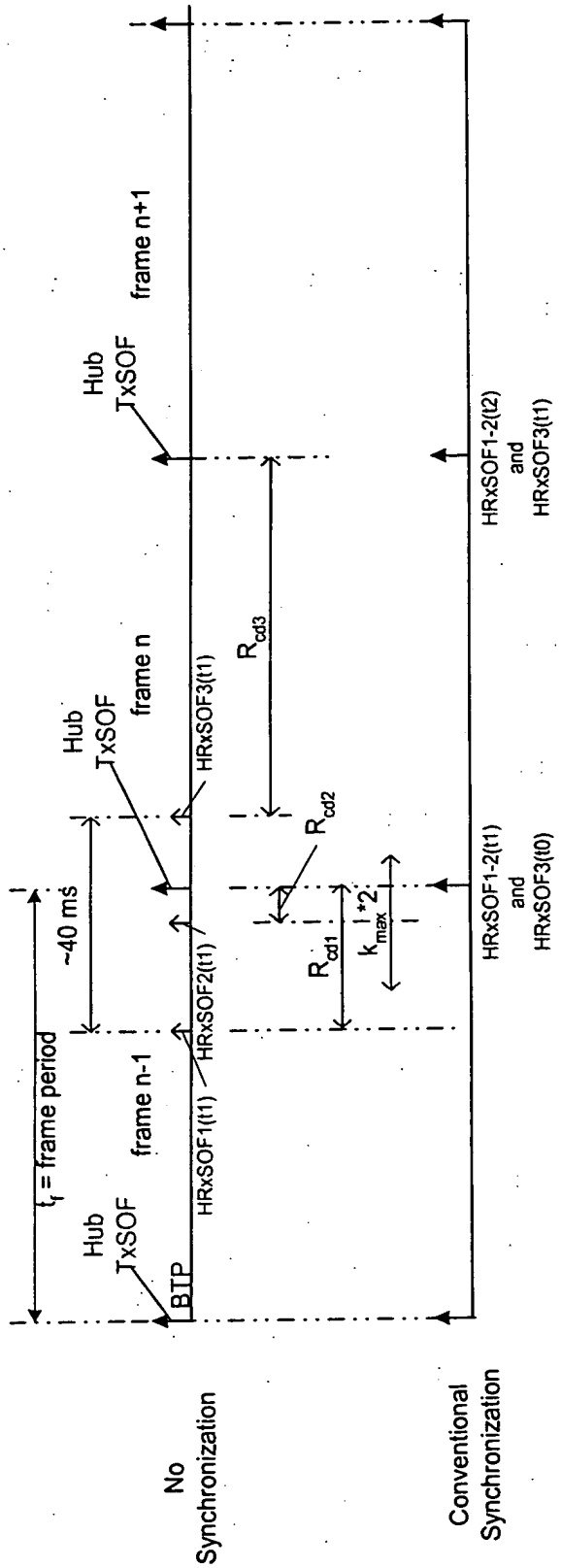


FIG. 2

Background Art

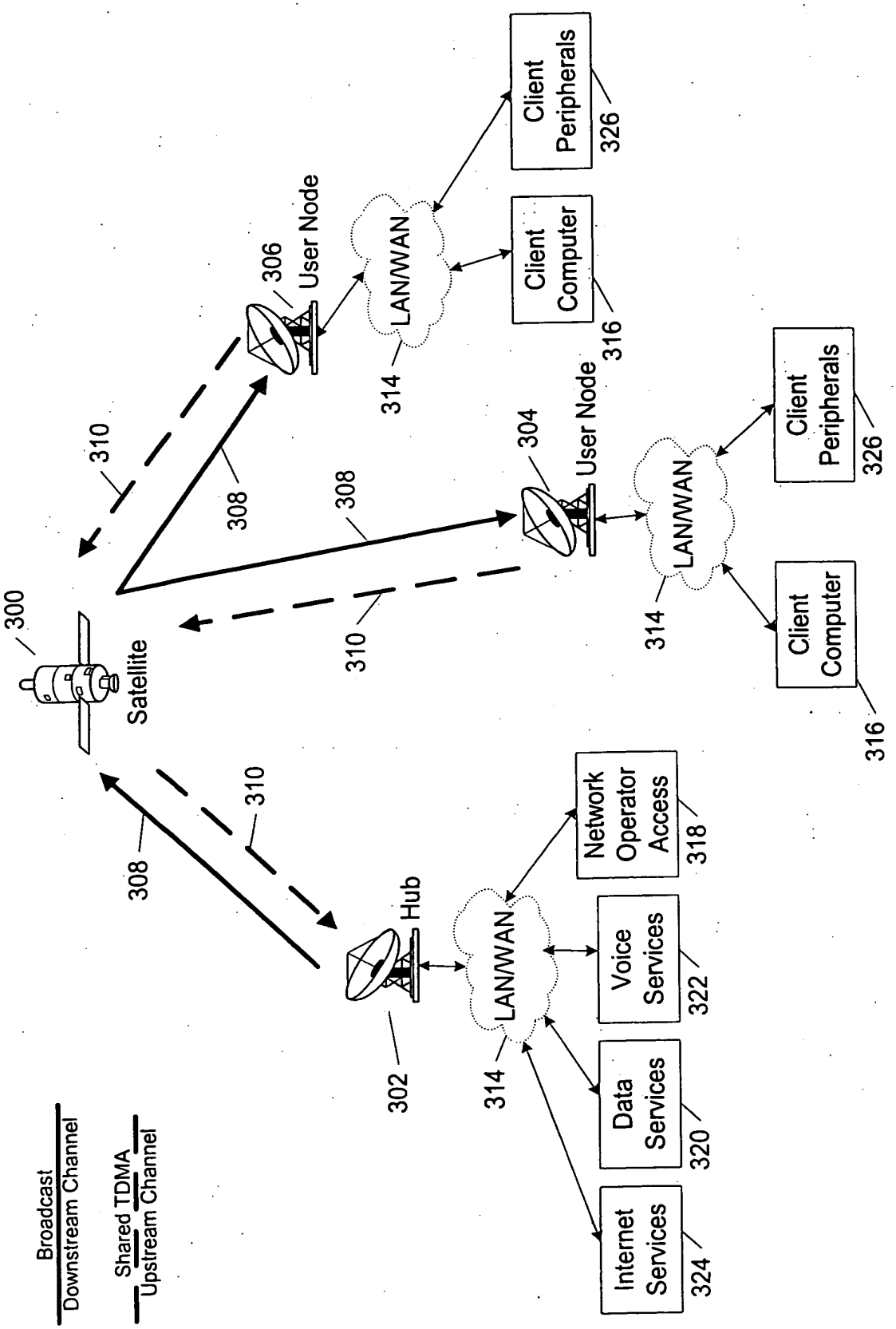

Broadcast
Downstream Channel
Shared TDMA
Upstream Channel
300
Satellite
302
Hub
304
User Node
306
User Node
308
308
308
310
310
310
314
LAN/WAN
314
LAN/WAN
314
LAN/WAN
316
Client Computer
316
Client Computer
316
Client Computer
318
Network Operator Access
320
Data Services
322
Voice Services
324
Internet Services
326
Client Peripherals
326
Client Peripherals

FIG. 3

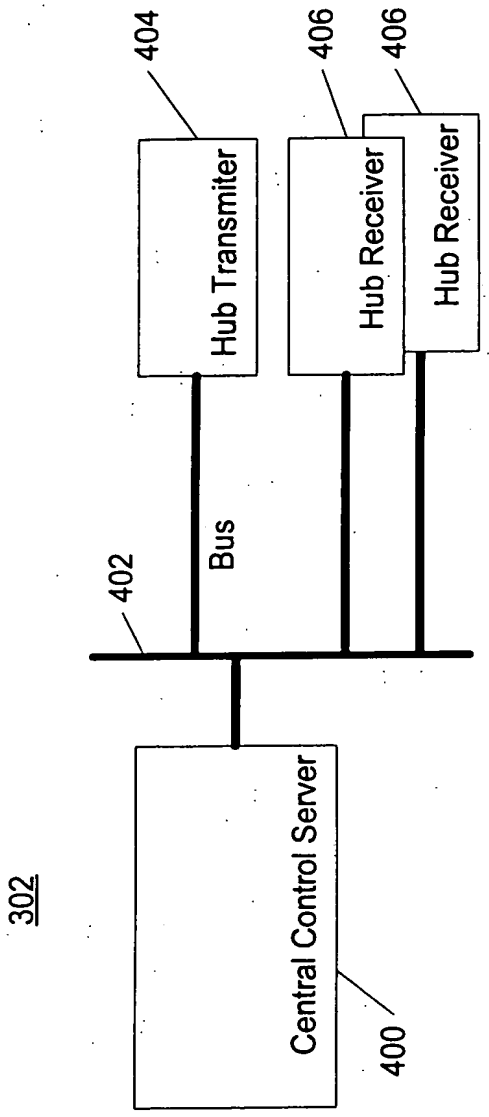

404
406
406
Hub Transmiter
Hub Receiver
Hub Receiver
Bus
402
302
Central Control Server
400

FIG. 4

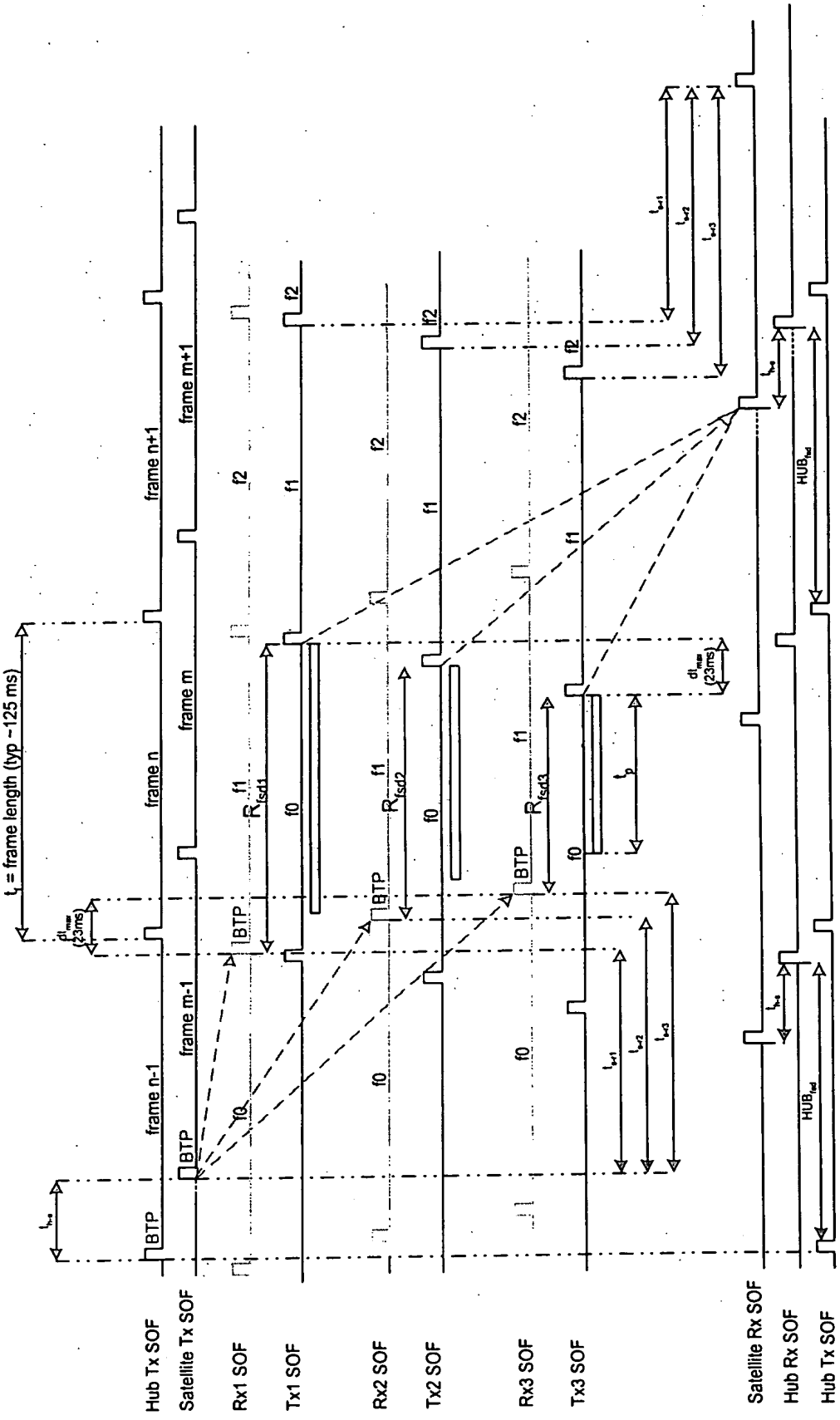

Hub Tx SOF
Satellite Tx SOF
Rx1 SOF
Tx1 SOF
Rx2 SOF
Tx2 SOF
Rx3 SOF
Tx3 SOF
Satellite Rx SOF
Hub Rx SOF
Hub Tx SOF
BTP
frame n-1
frame m-1
frame n
frame m
frame n+1
frame m+1
f0
f1
f2
t_f = frame length (typ ~125 ms)
(23ms)
HUB_fwd

FIG. 5

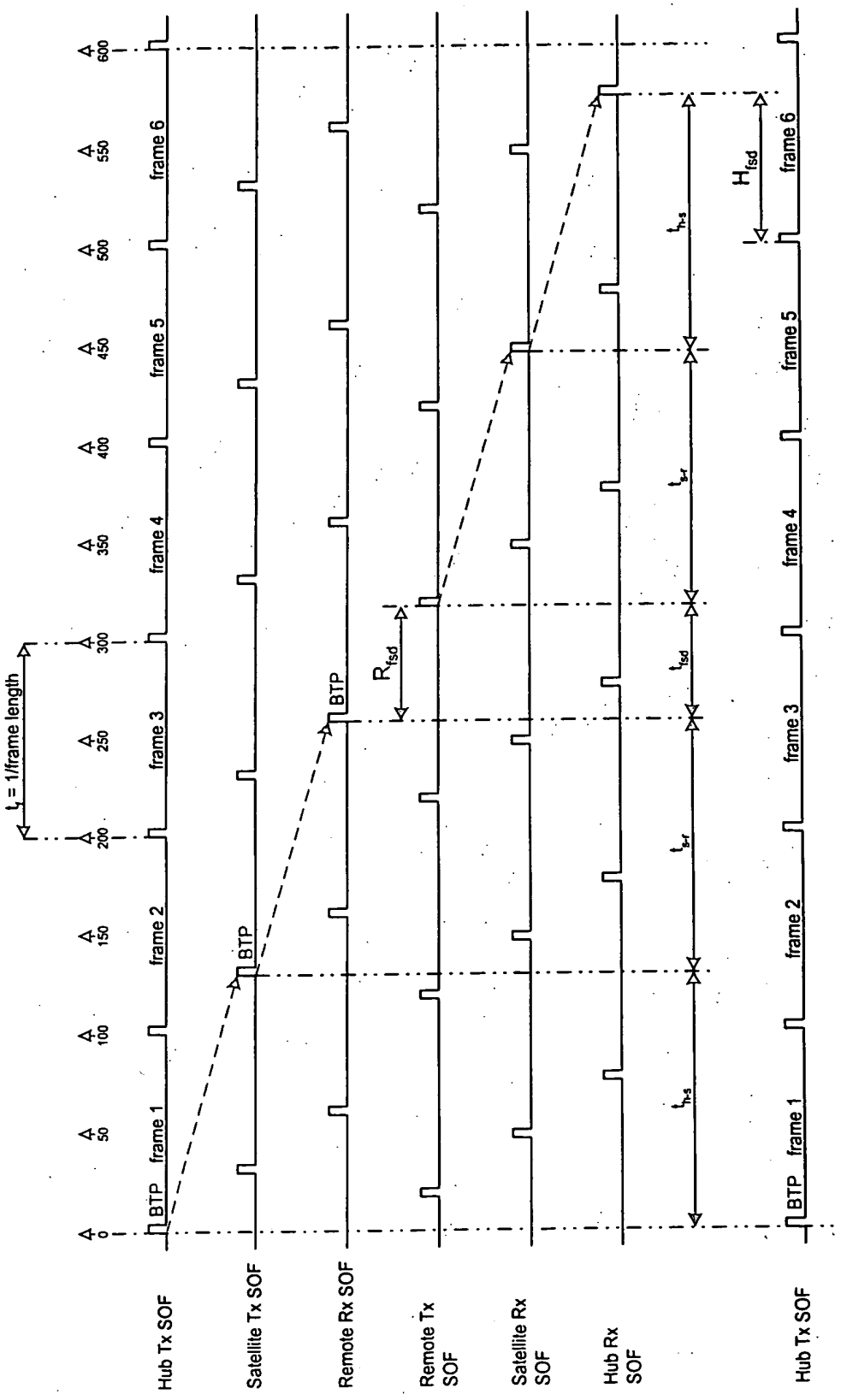

Hub Tx SOF
Satellite Tx SOF
Remote Rx SOF
Remote Tx SOF
Satellite Rx SOF
Hub Rx SOF
Hub Tx SOF
BTP
frame 1
frame 2
frame 3
frame 4
frame 5
frame 6
0
50
100
150
200
250
300
350
400
450
500
550
600
t_f = 1/frame length
R_{fsd}
H_{fsd}
t_{h-s}
t_{s-r}
t_{fsd}

FIG. 6

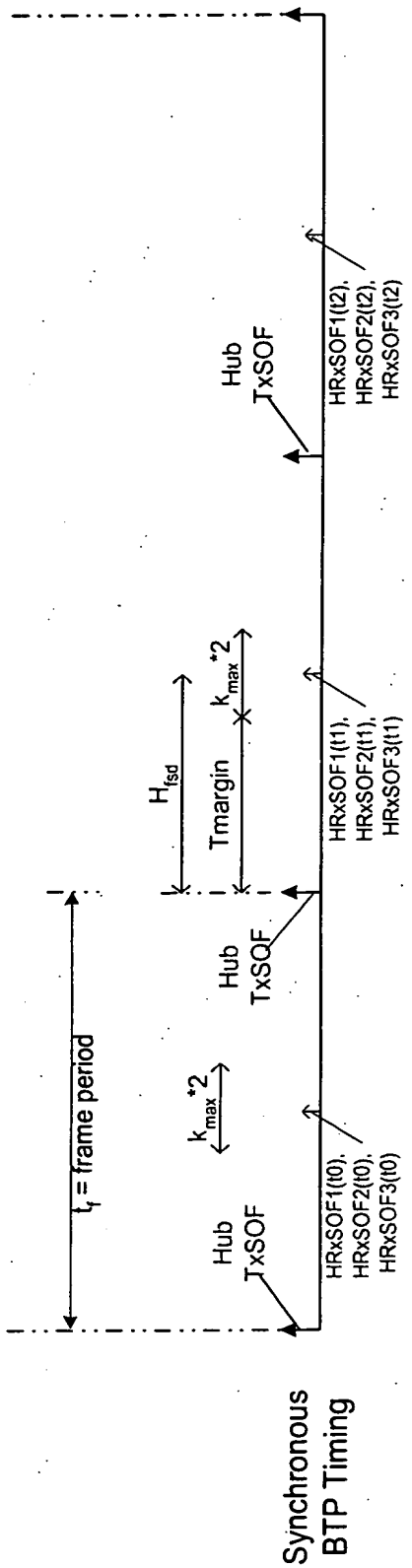

Synchronous BTP Timing
t_f = frame period
Hub TxSOF
HRxSOF1(t0), HRxSOF2(t0), HRxSOF3(t0)
k_{max} *2
Hub TxSOF
HRxSOF1(t1), HRxSOF2(t1), HRxSOF3(t1)
H_{fsd}
Tmargin
k_{max} *2
Hub TxSOF
HRxSOF1(t2), HRxSOF2(t2), HRxSOF3(t2)

FIG. 7

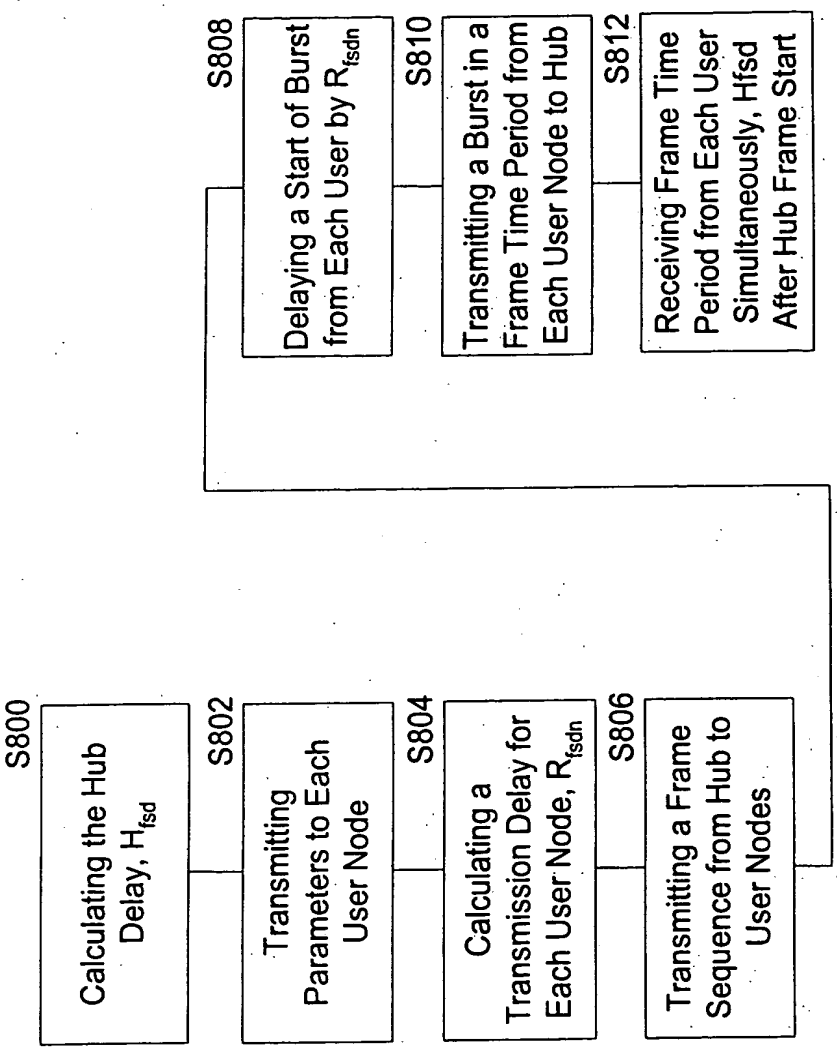

S800
Calculating the Hub Delay, H_{fsd}
S802
Transmitting Parameters to Each User Node
S804
Calculating a Transmission Delay for Each User Node, R_{fsdn}
S806
Transmitting a Frame Sequence from Hub to User Nodes
S808
Delaying a Start of Burst from Each User by R_{fsdn}
S810
Transmitting a Burst in a Frame Time Period from Each User Node to Hub
S812
Receiving Frame Time Period from Each User Simultaneously, Hfsd After Hub Frame Start

FIG. 8

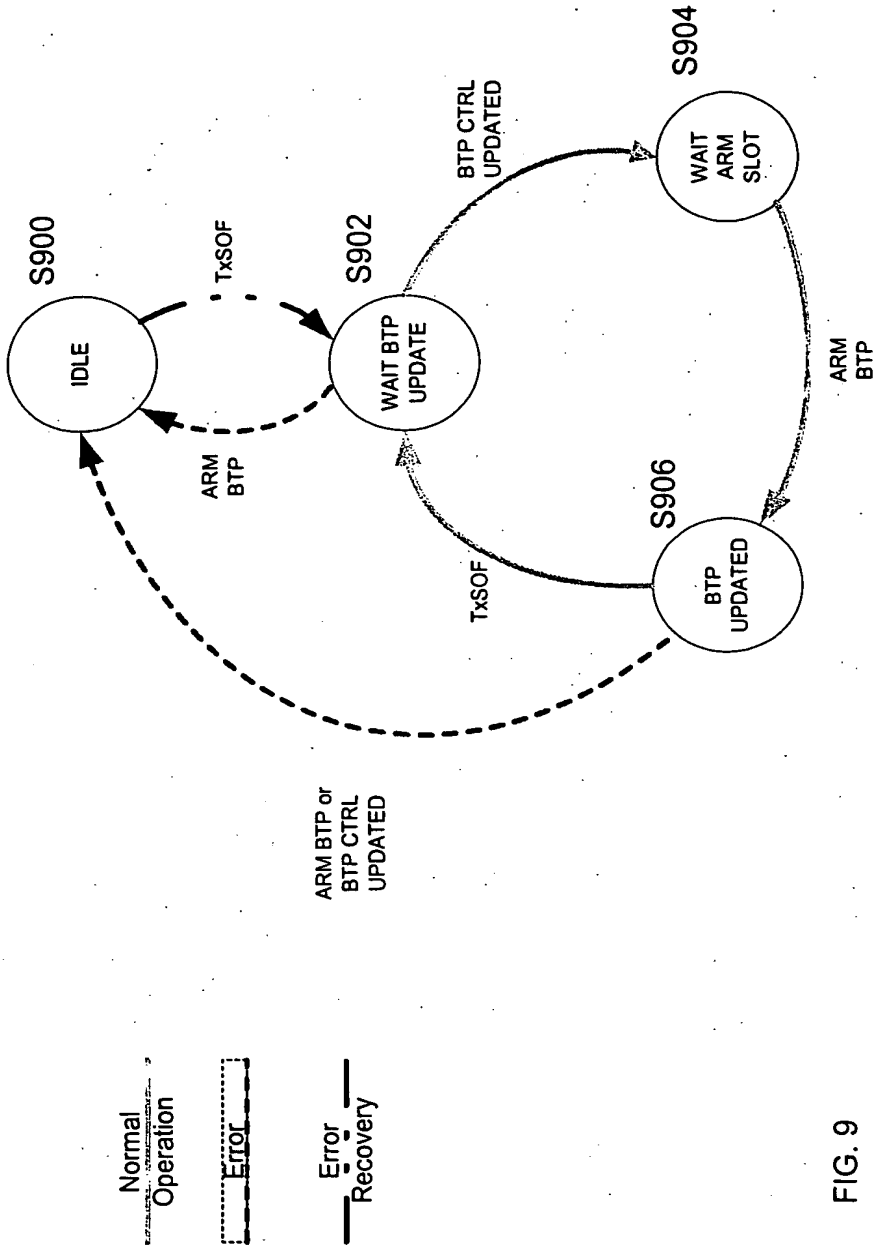

S900
IDLE
TxSOF
S902
WAIT BTP UPDATE
BTP CTRL UPDATED
S904
WAIT ARM SLOT
ARM BTP
S906
BTP UPDATED
TxSOF
ARM BTP
ARM BTP or BTP CTRL UPDATED
Normal Operation
Error
Error Recovery

FIG. 9

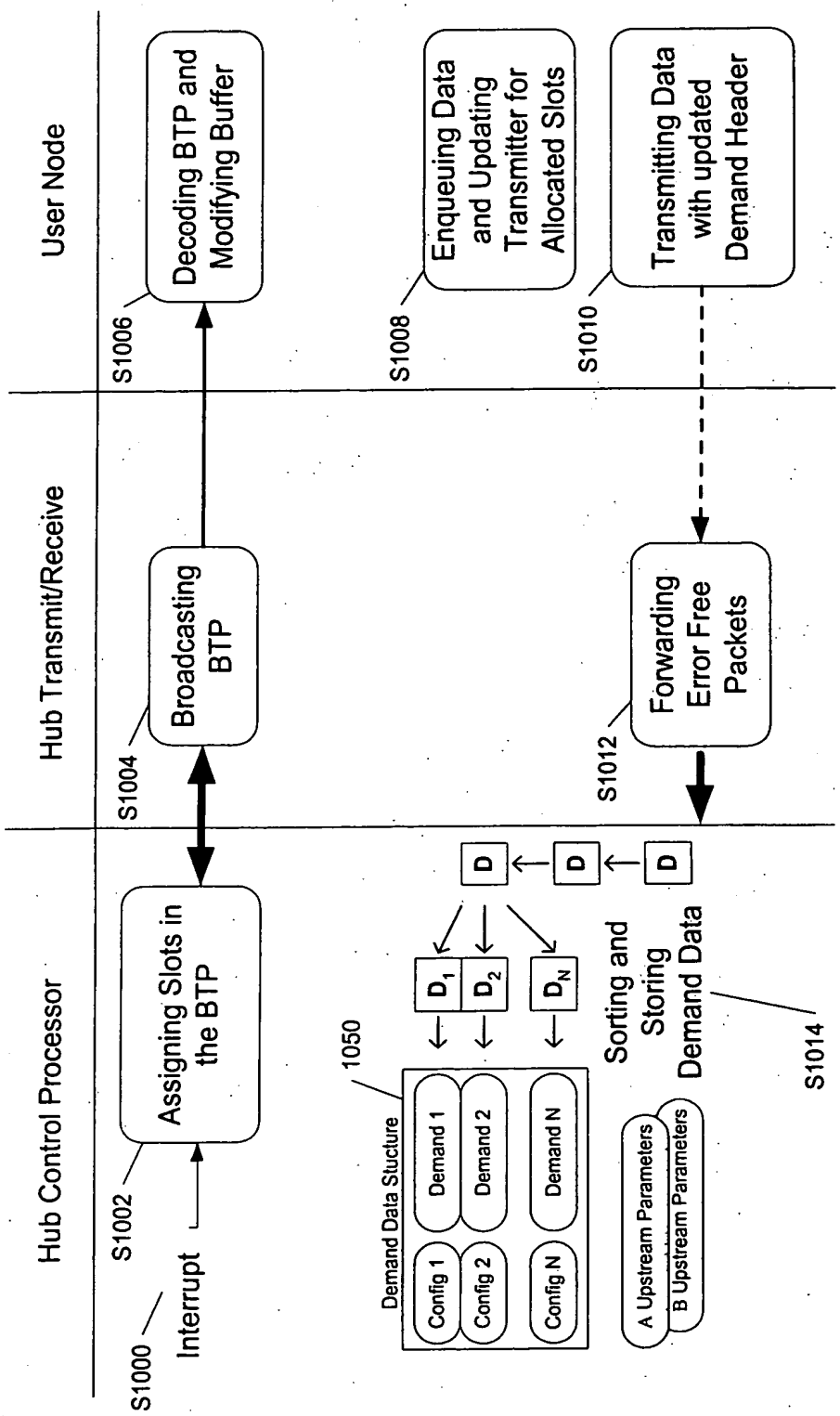

Hub Control Processor
Hub Transmit/Receive
User Node
S1000
Interrupt
S1002
Assigning Slots in the BTP
S1004
Broadcasting BTP
S1006
Decoding BTP and Modifying Buffer
S1008
Enqueuing Data and Updating Transmitter for Allocated Slots
S1010
Transmitting Data with updated Demand Header
S1012
Forwarding Error Free Packets
S1014
Sorting and Storing Demand Data
D
D
D
D1
D2
DN
1050
Demand Data Stucture
Demand 1
Demand 2
Demand N
Config 1
Config 2
Config N
A Upstream Parameters
B Upstream Parameters

FIG. 10

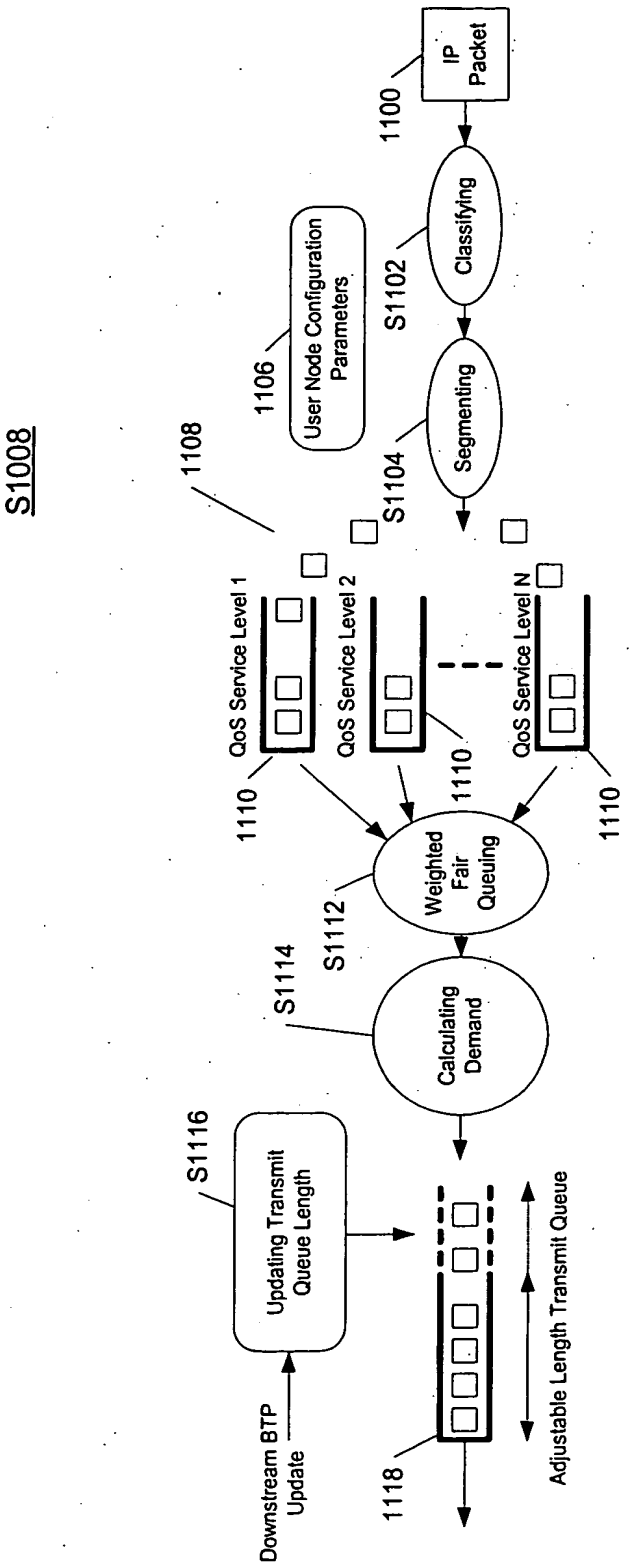

S1008
1100
IP Packet
Classifying
S1102
1106
User Node Configuration Parameters
Segmenting
S1104
1108
QoS Service Level 1
QoS Service Level 2
QoS Service Level N
1110
1110
1110
Weighted Fair Queuing
S1112
S1114
Calculating Demand
S1116
Updating Transmit Queue Length
Downstream BTP Update
1118
Adjustable Length Transmit Queue

FIG. 11A

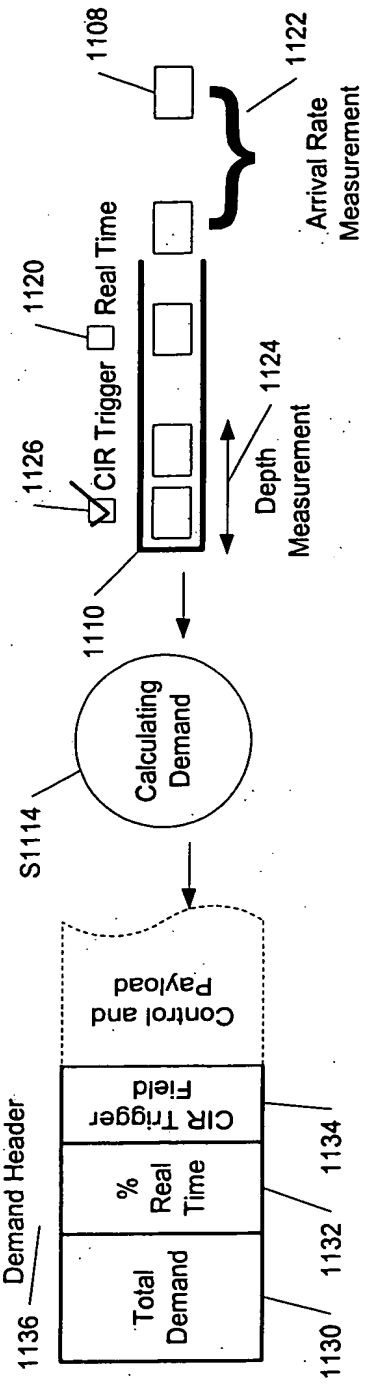

1108
1122
Arrival Rate Measurement
1120
Real Time
CIR Trigger
1126
1124
Depth Measurement
1110
Calculating Demand
S1114
Control and Payload
CIR Trigger Field
% Real Time
Total Demand
Demand Header
1136
1130
1132
1134

FIG. 11B

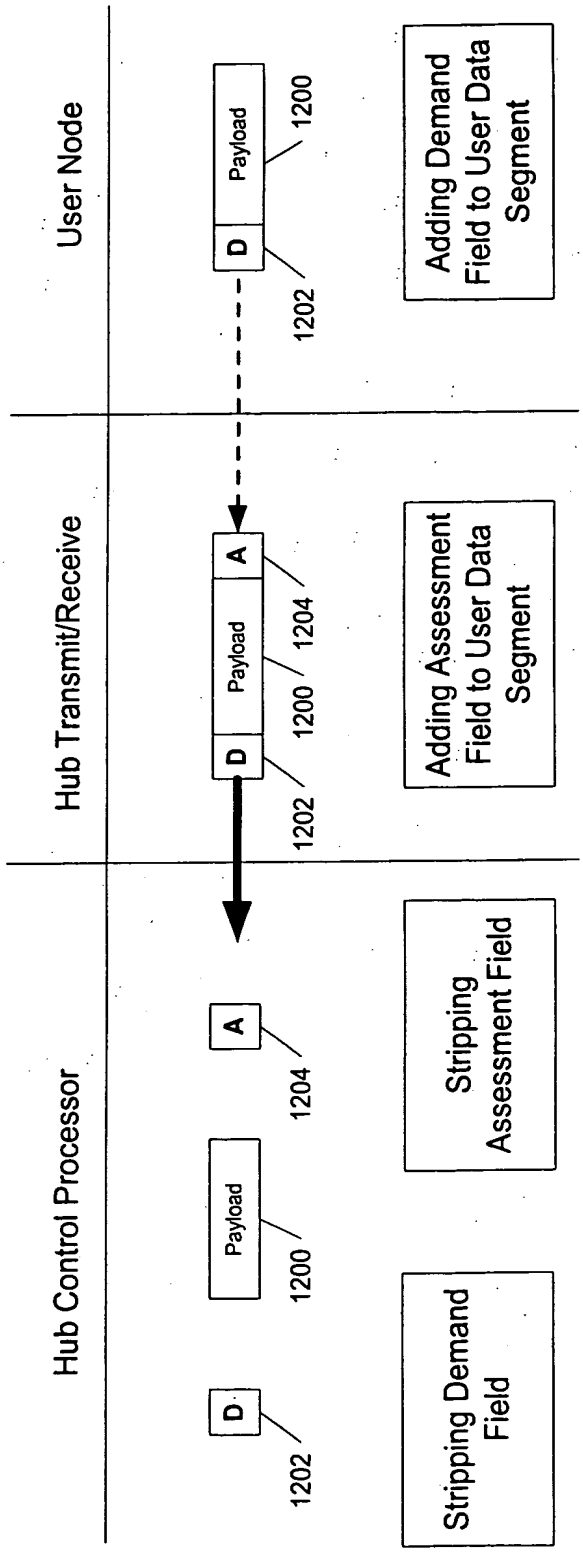

User Node
Hub Transmit/Receive
Hub Control Processor
D
Payload
A
1202
1200
1204
Adding Demand Field to User Data Segment
Adding Assessment Field to User Data Segment
Stripping Assessment Field
Stripping Demand Field

FIG. 12

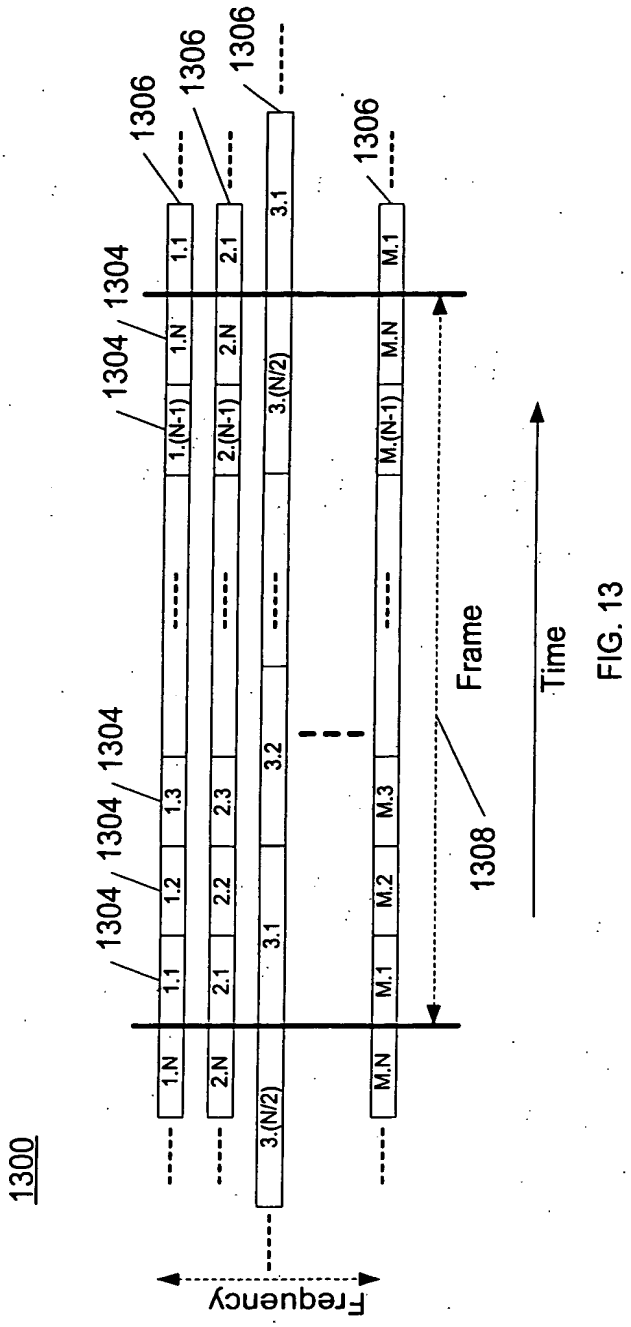

1300
1306
1304
1.1
1.2
1.3
1.N
1.(N-1)
2.1
2.2
2.3
2.N
2.(N-1)
3.1
3.2
3.(N/2)
M.1
M.2
M.3
M.N
M.(N-1)
Frame
1308
Time
Frequency

FIG. 13

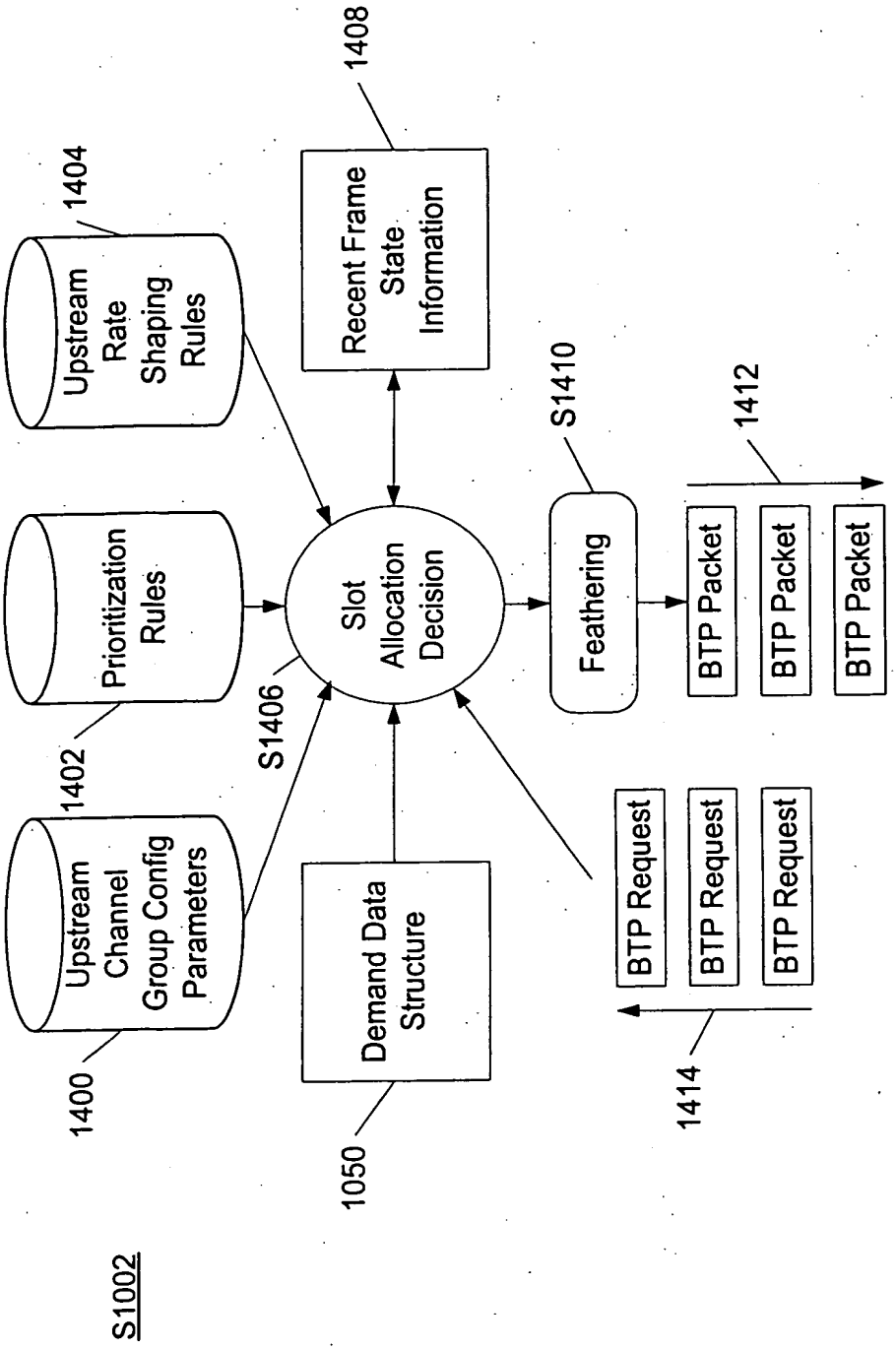
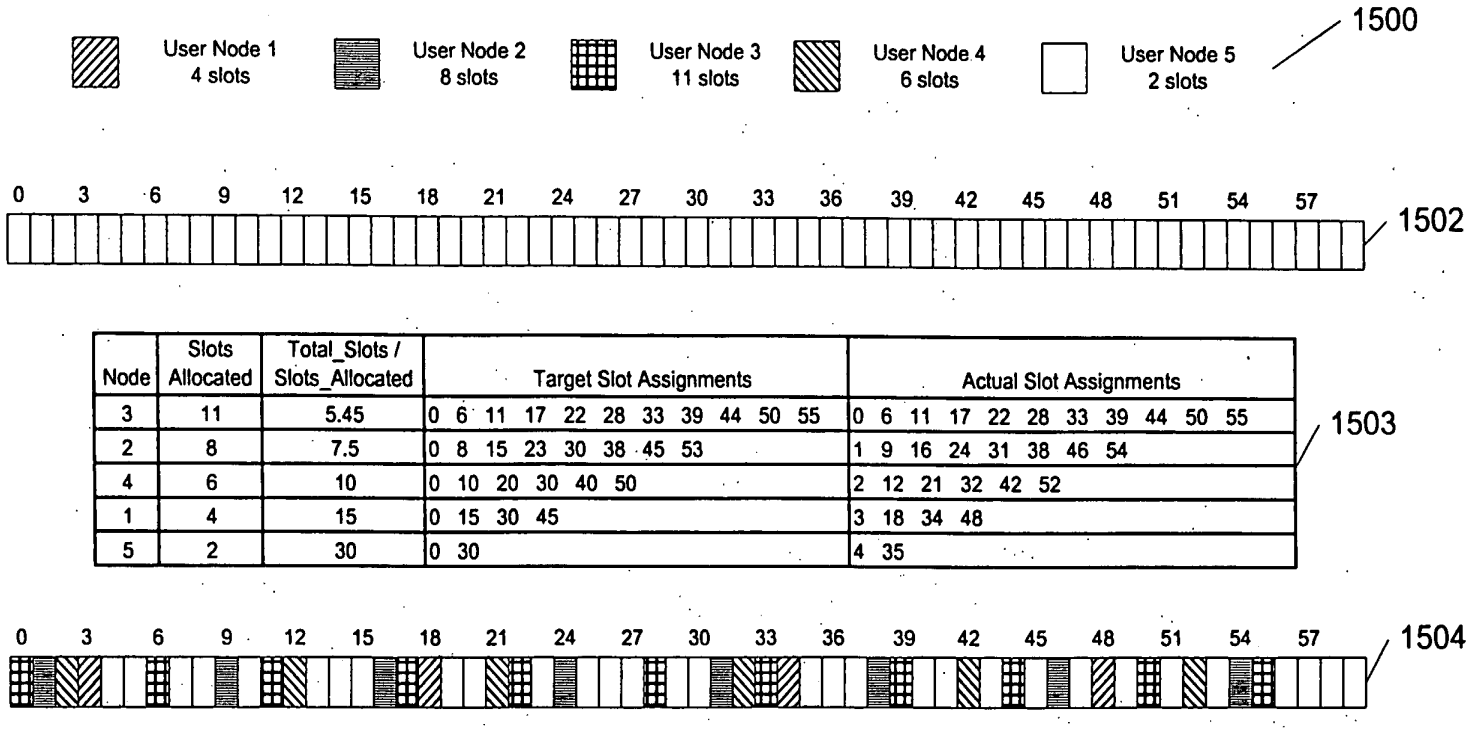

S1002
1400
Upstream Channel Group Config Parameters
1402
Prioritization Rules
1404
Upstream Rate Shaping Rules
1050
Demand Data Structure
1408
Recent Frame State Information
S1406
Slot Allocation Decision
S1410
Feathering
1412
BTP Packet
BTP Packet
BTP Packet
1414
BTP Request
BTP Request
BTP Request

FIG. 14



Node	Slots Allocated	Total_Slots / Slots_Allocated	Target Slot Assignments	Actual Slot Assignments
3	11	5.45	0 6 11 17 22 28 33 39 44 50 55	0 6 11 17 22 28 33 39 44 50 55
2	8	7.5	0 8 15 23 30 38 45 53	1 9 16 24 31 38 46 54
4	6	10	0 10 20 30 40 50	2 12 21 32 42 52
1	4	15	0 15 30 45	3 18 34 48
5	2	30	0 30	4 35

FIG. 15

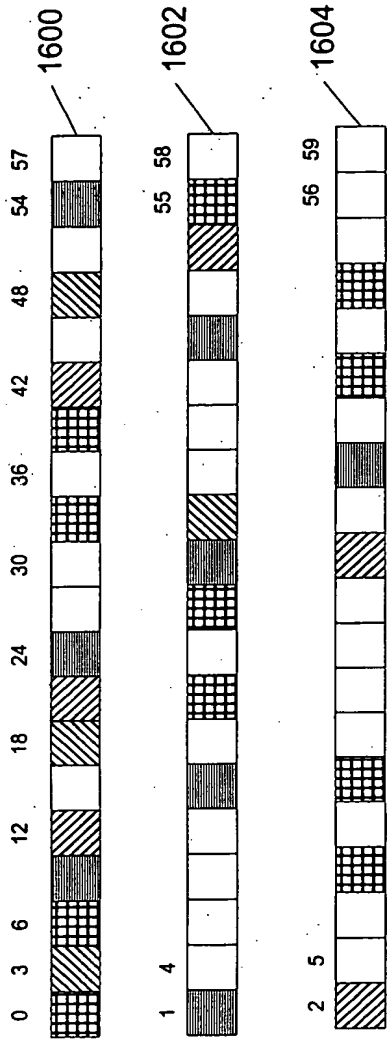

1600
1602
1604
0 3 6 12 18 24 30 36 42 48 54 57
1 4 55 58
2 5 56 59

FIG. 16

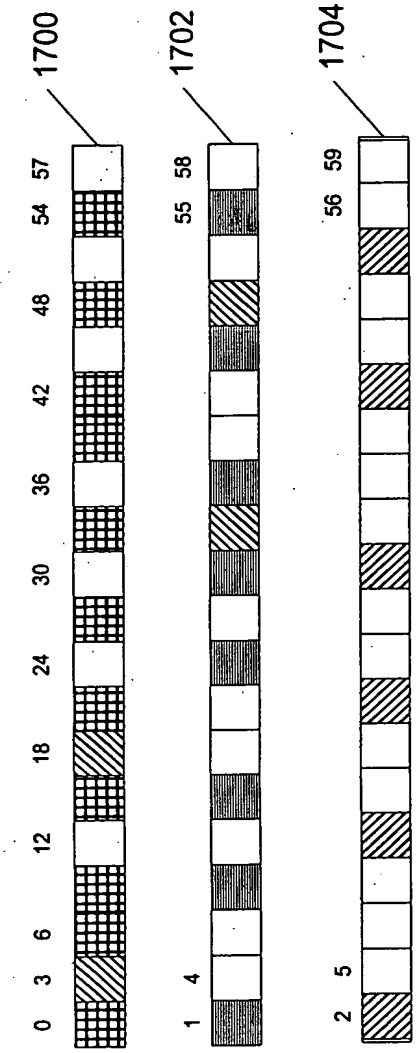

1700
1702
1704
0 3 6 12 18 24 30 36 42 48 54 57
1 4 55 58
2 5 56 59

FIG. 17

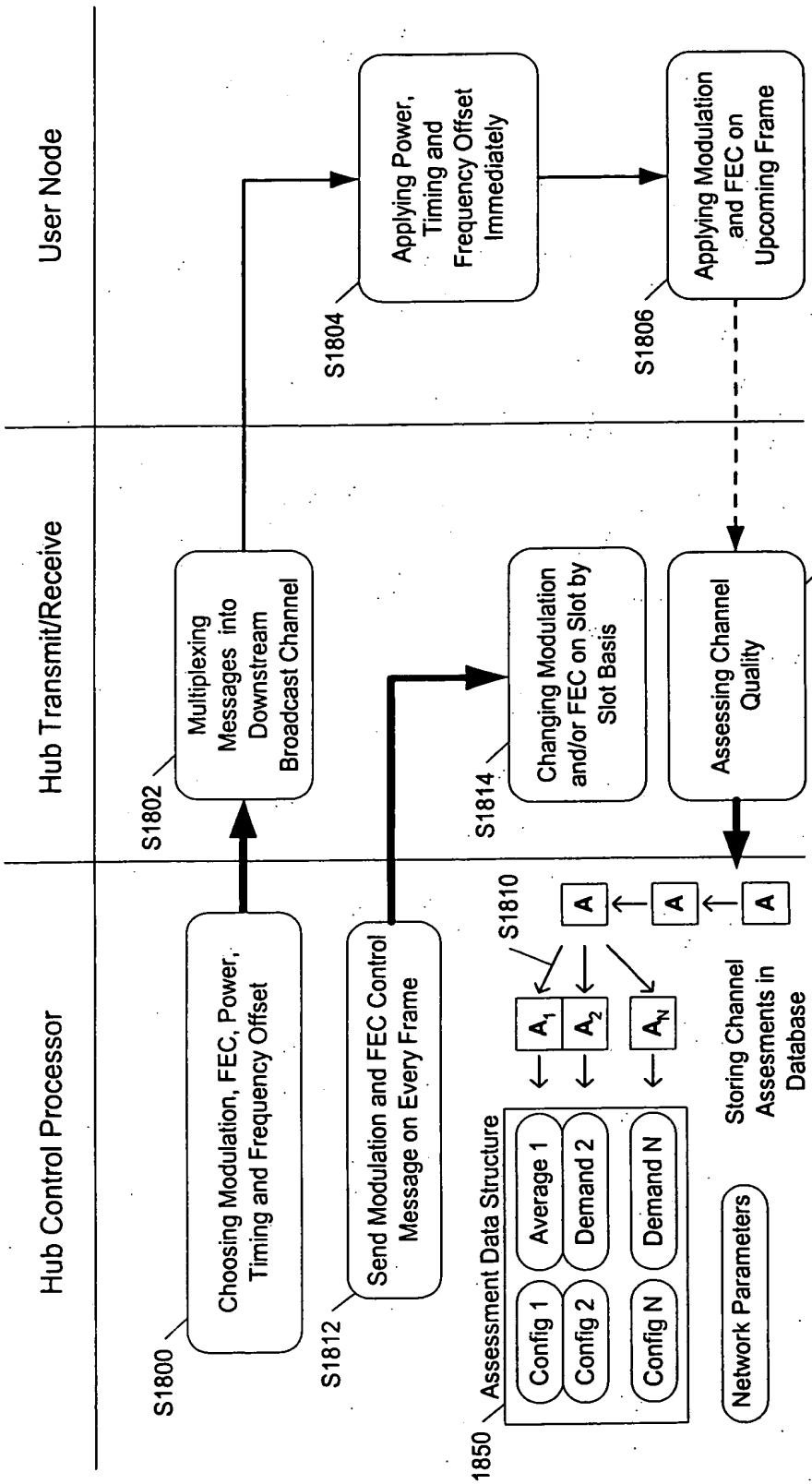

Hub Control Processor
Hub Transmit/Receive
User Node
Choosing Modulation, FEC, Power, Timing and Frequency Offset
S1800
Multiplexing Messages into Downstream Broadcast Channel
S1802
Send Modulation and FEC Control Message on Every Frame
S1812
Applying Power, Timing and Frequency Offset Immediately
S1804
Changing Modulation and/or FEC on Slot by Slot Basis
S1814
Applying Modulation and FEC on Upcoming Frame
S1806
Assessing Channel Quality
S1808
S1810
A
A
A
Storing Channel Assesments in Database
Assessment Data Structure
Config 1
Config 2
Config N
Average 1
Demand 2
Demand N
A1
A2
AN
1850
Network Parameters

FIG. 18

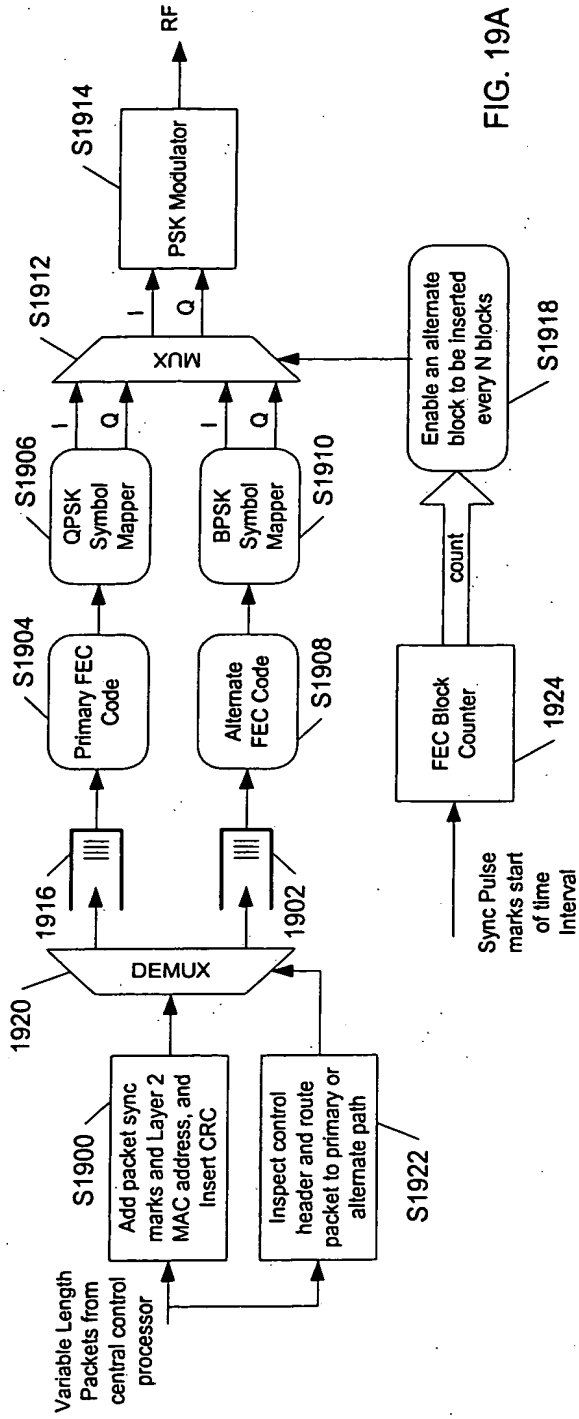


FIG. 19A

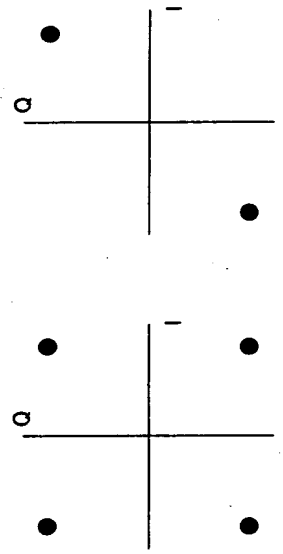


FIG. 19B

FIG. 19C

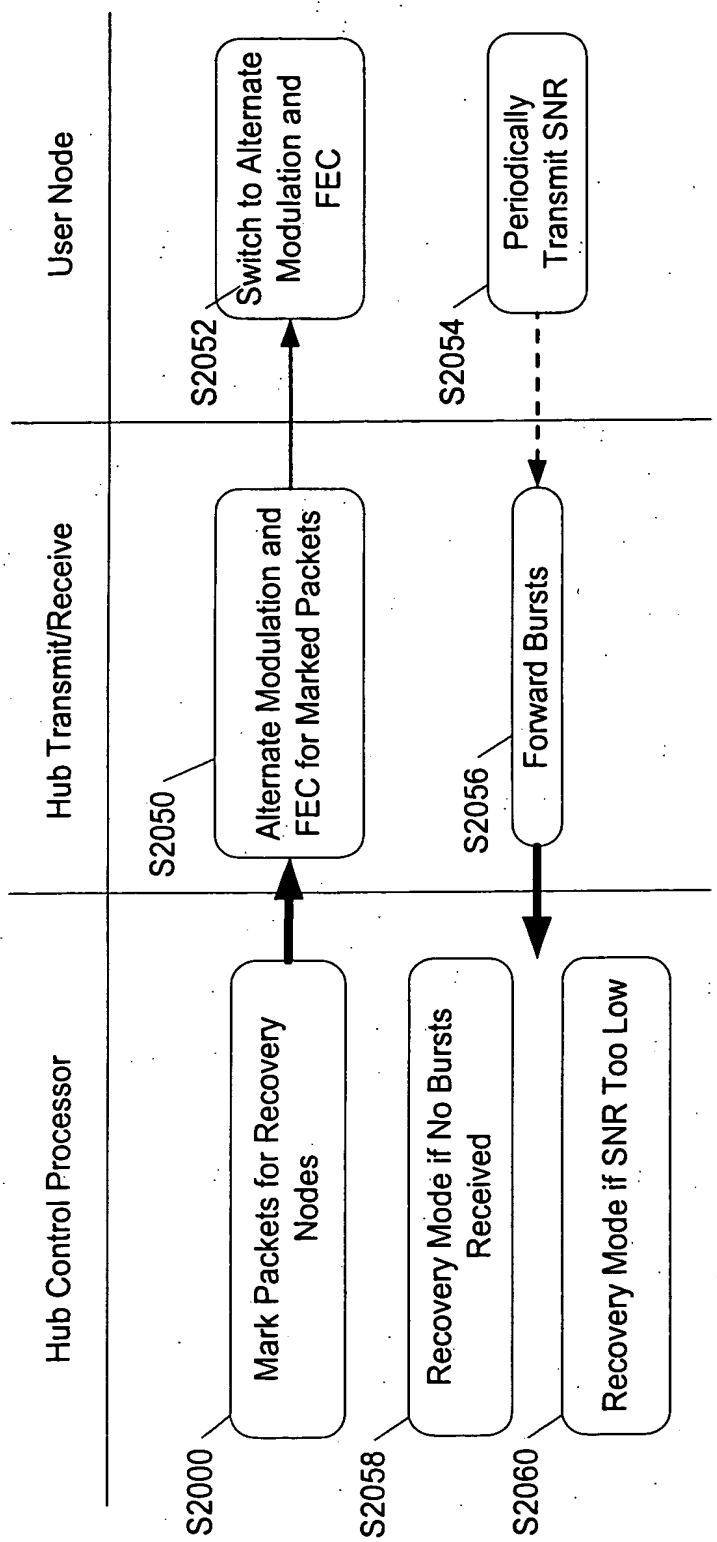

Hub Control Processor
Hub Transmit/Receive
User Node
Mark Packets for Recovery Nodes
S2000
Alternate Modulation and FEC for Marked Packets
S2050
Switch to Alternate Modulation and FEC
S2052
Recovery Mode if No Bursts Received
S2058
Forward Bursts
S2056
Periodically Transmit SNR
S2054
Recovery Mode if SNR Too Low
S2060

FIG. 20

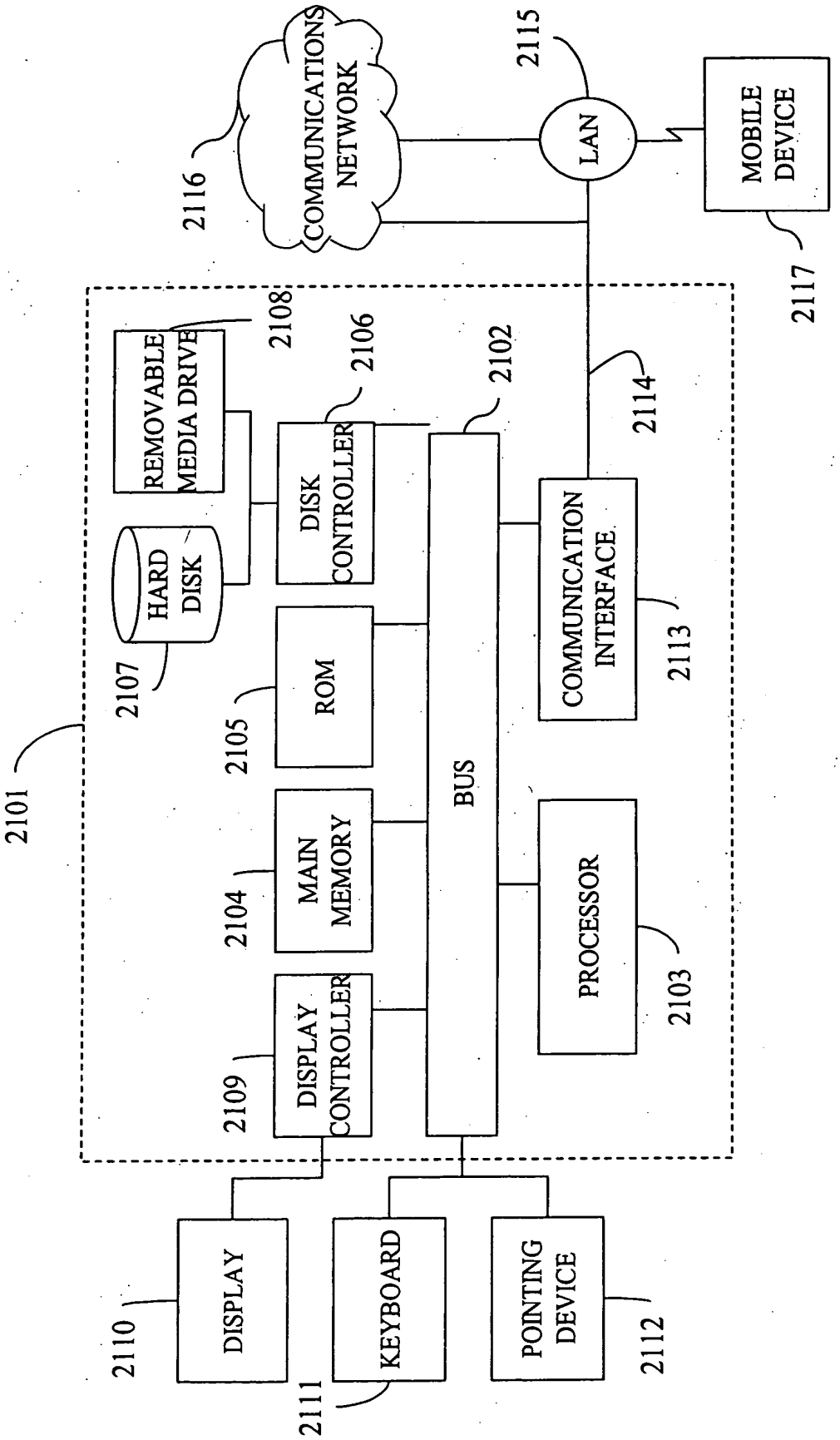

2116
COMMUNICATIONS NETWORK
2115
LAN
MOBILE DEVICE
2117
2101
REMOVABLE MEDIA DRIVE
2108
HARD DISK
2107
DISK CONTROLLER
2106
2102
2114
ROM
2105
BUS
COMMUNICATION INTERFACE
2113
MAIN MEMORY
2104
PROCESSOR
2103
DISPLAY CONTROLLER
2109
DISPLAY
2110
KEYBOARD
2111
POINTING DEVICE
2112

FIG. 21

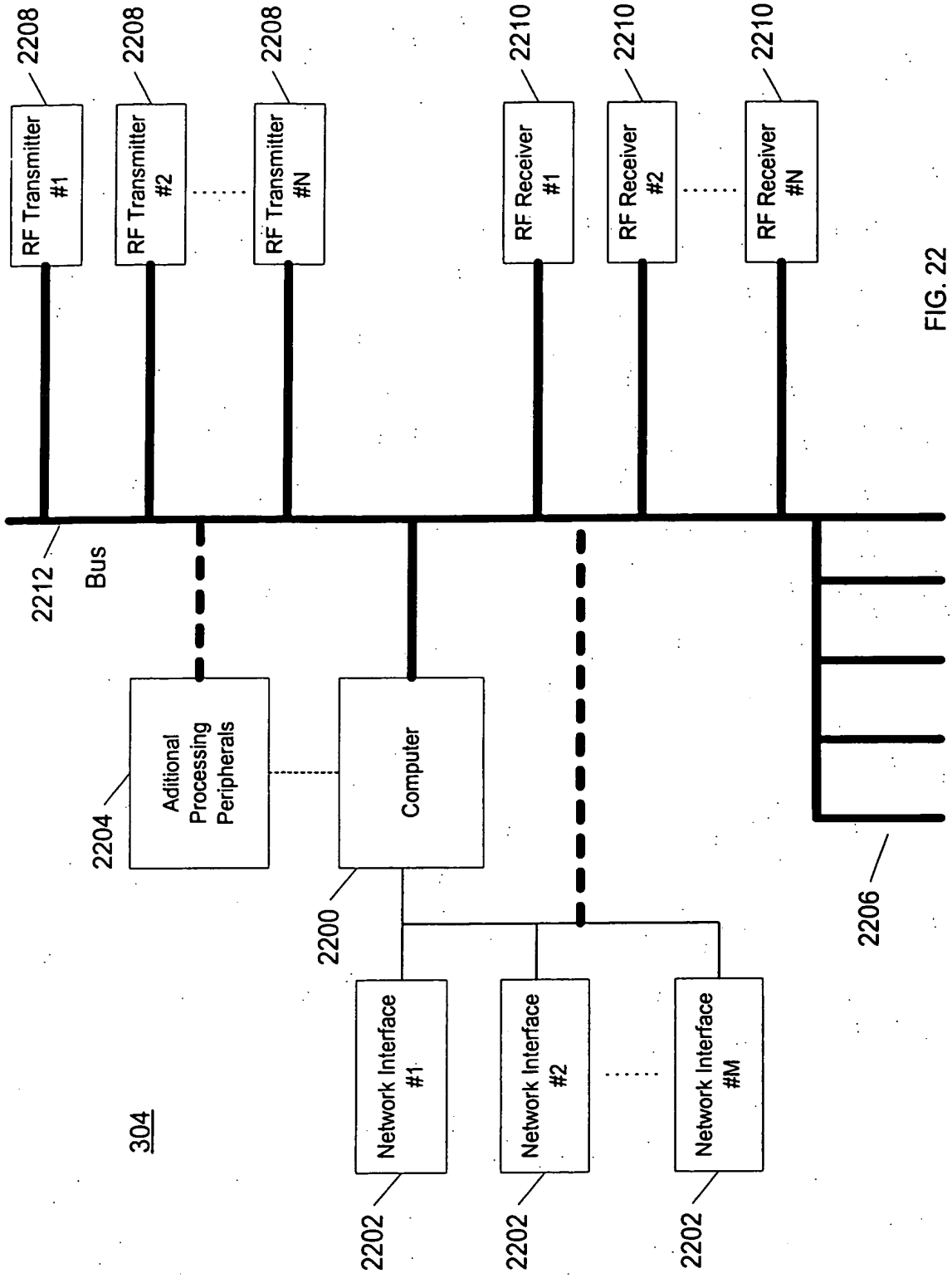

2208
RF Transmitter #1
2208
RF Transmitter #2
2208
RF Transmitter #N
2210
RF Receiver #1
2210
RF Receiver #2
2210
RF Receiver #N
2212
Bus
2204
Aditional Processing Peripherals
Computer
2206
Expansion Peripheral Connections
2200
304
Network Interface #1
Network Interface #2
Network Interface #M
2202
2202
2202

FIG. 22